

Research - Performance Research

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Abstract

Performance research and benchmarking methodology.

Performance Research

Overview

Performance research and benchmarking methodology.

Key Papers

Title	Author	Year
“Tail at Scale”	Google	2013
“Latency Lags Bandwidth”	Patterson	2004
“The C10K Problem”	Kegel	1999
“The C10M Problem”	2013	

Benchmarking Methodology

Metrics

throughput:

- Requests per second (req/s)
- Transactions per second (TPS)
- Bits per second (throughput)

latency:

- P50 (median)
- P95 (95th percentile)
- P99 (99th percentile)
- P999 (99.9th percentile)

reliability:

- Error rate
- Timeout rate
- Connection reset rate

Benchmarking Standards

tooling:

- k6 for HTTP load testing
- wrk2 for latency analysis
- h2load for HTTP/2 testing
- hey for quick benchmarks

methodology:

- Warmup period: 30 seconds
- Steady state: 5 minutes
- Cooldown: 30 seconds
- Repeat: 3 times
- Report: Median of runs

Performance Patterns

Lock-Free Data Structures

used for:

- Route table
- API key cache
- Connection pool

benefits:

- No contention
- Predictable latency
- Scale with cores

SIMD Optimization

used for:

- JSON parsing (simd-json)
- HTTP header parsing
- Base64 encoding

speedup:

- JSON: 5-10x vs standard parsing
- Headers: 3-5x vs byte-by-byte

Next

- [Benchmarking Methodology](#)

See Also

Related research, architecture, and whitepaper documentation.

- [Research Overview](#)
- [Architecture Overview](#)

- [Whitepapers](#)
- [Performance Research](#)